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Transformative learning and grassroots climate adaptation: case studies in Vietnam's Mekong delta

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Abstract

This paper aims to understand how T-learning helps communities achieve better sustainability outcomes. On the basis of an intensive literature review and field research conducted in the Mekong Delta of Vietnam, the paper proposes a substantial linkage between T-learning and sustainability. It first outlines the environmental changes in Vietnam's Mekong Delta, which appear to serve as "disorienting dilemmas" that force local people to learn and gradually shift their farming practices to align with a climate-resilient development. The paper relies on the outcomes of household surveys, field observations and focus group discussions to explore the impacts of T-learning on building adaptive capacity and sustainability transition in two community-based projects in Can Tho City and Ca Mau province in the Mekong Delta. Our findings reveal that T-learning enables experts and practitioners to introduce new ideas and accordingly mobilize local people to make changes without inciting doubt, dismay or concern. In an ideal T-learning approach, small-scale farmers learn from being under the supervision of experts in "field-based schools" that offer real-life experience and encourage learners to shift their livelihoods to eco-friendly agricultural practices. The paper sheds new light on how a critical approach to education for sustainable development through T-learning can be, under specific conditions, one strategy. It concludes that T-learning should be acknowledged as a potentially important part of the broader approach to climate-resilient development in vulnerable grassroots communities.

Keywords

climate-resilient development, climate adaptation in Mekong Delta, community action, education for sustainable development (ESD), mangrove-shrimp farming system, transformative learning

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Introduction

As progress in global climate negotiations remain limited, greater attention is being given to the increasing number of grassroots sustainability initiatives (Mezirow and Taylor 2009; Cole 2015; Kent 2016). In Vietnam, the government has proactively introduced a number of environmental policies recently in its quest for sustainable development. However, limited resources and climate governance capacity have challenged and impeded their efforts to mitigate and adapt to the tangible impacts of climate and human-caused environmental changes (Mongabay 2016; The Diplomat 2017a). While awaiting the government's responses on the climate change national initiative, smallholder farmers in the Mekong Delta have proactively found new strategies to adapt to the changing environment expressed by erratic rainfall, increased flooding, extended droughts and salt-water intrusion (Chiem 2012; The Diplomat 2017b). Their new farming models, supported by non-state actors such as experts and NGOs, have proved successful and have been widely acknowledged as a climate-resilient alternative (Chandra et al. 2016; Kent 2016). The key to their success is that their farming models can increase their incomes while ensuring environmental friendliness, and thus proving the possibility of scaling up (Chiem 2012; Quang and Weatherby 2019).

The emergence of grassroots climate adaptation initiatives calls for adult learning strategies that promote the adaptive capacity of grassroots communities, and enable communities to develop sustainably. Recent scholarship has sought to theorize transformative learning, or T-learning, in terms of its potential to promote sustainability transition (Moore 2005; Wals and Corcoran 2006; Taylor and Cranton 2012). However, it remains unclear how T-learning might help communities achieve better sustainability outcomes, and there are few empirical examples that demonstrate the impacts of T-learning on community-based collective climate actions. This further highlights the need to continue theorizing grassroots climate action in terms of their sustainability transition potential with which T-learning is an integral part in intra- and inter-community education. This paper aims to address these two gaps.

We study the impacts of T-learning on grassroots sustainable development in the case of specific agricultural areas in the Mekong Delta, where local communities are most vulnerable to the negative impact of environmental changes, due to their heavy dependence on natural resources of water, soil, weather, and flora and fauna (Mongabay 2016). Conceptually, the process of T-learning emerged in response to the "disorienting dilemma" – an experience, or self-perception, that no longer fits into a new situation (Mezirow and Taylor 2009), and thus, forces people to reconsider their beliefs and lifestyles through "critical reflection" in the context of dialogue with their community. In disaster-prone regions, such as the Mekong Delta, ongoing environmental injustices serve as a key "disorienting dilemma" for individuals (e.g. farmers, women, and ethnic groups) who must shift their behaviors and lifestyle choices to align with a low-carbon future that is sustainable.

The good news might be that there is an increased interest in developing approaches that are locally effective and can be rolled out locally under the banner of "grassroots

sustainability initiatives" (Mezirow and Taylor 2009; Chiem 2012; Kent 2016). This is not only about technical fixes to arrest adverse climate impacts – it is about local-level learning and harvesting ideas; about the potential of affected rural groups to mobilize and participate in novel networks – ideally including sympathetic local (commune/district) government officials. Yet, the catalysts in the cases presented below are what we may call "civil society networks" – a mix of dedicated and motivated people ready to work together: male and female farmers, agricultural and water management experts, academics, local community-based organizations (CBOs) and NGOs.

Against this background, this paper seeks to address the questions as follows: what is grassroots T-learning and how does it promote community climate action in disaster prone areas such as the Mekong Delta? Second, the potential for T-learning exists to influence grassroots activism against climate change, thus holding the key to sustainability transition and broader climate change governance. So, in what ways can T-learning promote and underpin the community-based collectives to climate resilient development in accordance with sustainability needs? In other words, does T-learning lead to sustainability? If yes, how can it best be implemented as an alternative approach to sustainable development at the local level?

This paper aims to clarify the importance of T-learning in grassroots climate action and why it should be acknowledged as a ground-up approach to education for sustainability. It first presents an overall understanding of T-learning and the prevailing approach in academic environments that stresses the relationship with grassroots T-learning. It then provides a real-life example of T-learning theory in action and analyzes T-learning's significant impacts on local sustainability-driven changes. The factors constituting the success of grassroots T-learning in achieving more widespread adoption outside are also mentioned in this section. The next section discusses the relationship between T-learning and sustainable community development through which the role of T-learning as a critical ground-up approach to education for sustainability is clarified and resolved naturally. The paper concludes with a discussion on issues and challenges facing grassroots T-learning, including the significant role of local youth and students in up-scaling T-learning activities.

Understanding T-Learning: from theory to practice

Originated by Jack Mezirow (1990; 1991), T-learning is known as a theory that describes a process of examining, questioning, and revising people's perceptions of their experiences that they interpret in their own way. As the goal of education is, among other things, to find universal truths and constructs that are independent of our knowledge of them, we develop habitual expectations and assumptions based on past experiences and expect things to be as they were before. But when we encounter a situation that is not congruent with our expectation, we begin to reconsider the existing perspectives that guide our decision making and actions and enter into a process that could lead to a transformed perspective (Taylor and Cranton 2012). Some scholars

define T-learning as a learning process that "transforms problematic frames of reference to make them more inclusive, discriminating, reflective, open, and emotionally able to change" (Mezirow and Taylor 2009; Howie and Bagnall 2013). However, the common notion of T-learning is the dominance of individualization of responsibility for mainstream change. In some contexts, social change may need to precede individual change, and in others, individual change drives social transformation. Thus, an individual shift in perspective holds the key to broader community and social change.

Mezirow (2009) argues that people likely consider changing their view of the world when they face a "disorienting dilemma" – an experience that no longer fits into emerging circumstances or beliefs. When faced with a disorienting dilemma, people are forced to reconsider their understanding and look for a new, appropriate way to fit the new experience into the rest of their worldview. This process of "self-adjustment" often happens through "critical reflection" in the context of dialogue with other actors, including academics and those who pursue interests conflicting with theirs (Howie and Bagnall 2013). Such a transformative process is comprised of ten phases as follows: A disorienting dilemma →Self-examination →A critical assessment of assumptions → Recognition of a connection between one's discontent and the process of transformation →Exploration of options for new roles, relationships, and action →Planning a course of action →Acquiring knowledge and skills for implementing one's plan →Provisional trying of new roles →Building competence and self-confidence in new roles and relationships →A reintegration into one's life on the basis of conditions dictated by one's new perspective (Mezirow 2009).

T-learning is an emerging approach increasingly preferred at school and community education. At public schools, teachers utilize disorienting dilemmas to challenge students' thinking, encouraging them to use critical thinking and questioning to verify their underlying assumptions and beliefs, and look for new experiences or perspectives (Christie et al. 2015). In the context of academic learning environments, disorienting dilemmas often occur when teachers provide space to critically engage with new ideas. To utilize T-learning in classrooms, teachers firstly need to provide enough space and opportunities for students' critical thinking by enabling students to engage with new content through journaling, engaging in dialogue with their peers, and critically questioning their own assumptions and beliefs. Once students have challenged their own assumptions and beliefs, it is critical for teachers to provide the opportunity for students to act on their newfound beliefs.. This step is necessary since "true transformation" cannot take place as long as students are able to actively take steps that acknowledge their new belief (which is either right or wrong) (Howie and Bagnall 2013; Christie et al. 2015).

However, teachers must consider sustaining students' transformed perspective by providing opportunities to relate to others going through the same transformative process. Transformation often happens in community as students bounce ideas off one another and are inspired by the changes that their friends and acquaintances make. In other words, the disorienting dilemmas in academic environments and those in communities look more or less alike, and students likely prefer to act as their parents and neighbors usually do – whose ways are sometimes different, or even contradict what they gleaned at school.

Despite this understanding and relationship between fostering T-learning at school and in communities, the role of T-learning in the community generally remains under-researched in Vietnam. We recognize that local farming communities can be acknowledged as a natural point for sustainability education. Their position in policy processes, which is often marginalized, motivates them to support equitable development approaches as both the first beneficiaries and the future victims of mismanagement.

On the other hand, the Mekong Delta will soon be the country's "next environmental hotspot" due to the proliferation of factories and other potential polluters along the waterways (The Diplomat 2017a). So, the logic behind it is that if local communities want sustainable development, they need transformative learning to improve their own resilience capacity and become aware of, and implement, clear, workable alternatives. Pursuing climate-smart livelihoods would help them gain better incomes but avoid far-reaching environmental impacts that their children will be forced to bear in the rather near future. Local peasants therefore have an opportunity to help determine an alternative policy to self-help climate resilient development in the Delta. But this is only true if they are fully engaged in the T-learning process, which offers an ideal platform for enhancing their capacity and real-life experience (Mezirow and Taylor 2009; Christie et al. 2015).

The following section presents the development of grassroots T-learning in the Mekong Delta through which major elements that frame the T-learning approach and the impacts of T-learning on local sustainability transition are identified and analyzed.

Background to study: dawn of T-Learning in the Mekong Delta

The Mekong Delta is an interesting case study of grassroots climate action given that it well represents the adverse impacts of climate and human-caused environmental changes on local communities and there have been a large number of adaptation strategies implemented by state and non-state actors (Mongabay 2016; The Washington Times 2016; The Diplomat 2017a, b; Strauch et al. 2018). As a result, over time it has become like a laboratory of different approaches to meet ever increasing challenges. Some came in the shape of central government policy dictates from Ha Noi, some were promoted through external donor agencies, and others initiated by individual farmers with or without the support of local CBOs and NGOs. In terms of policy, many interventions did not take heed of the ongoing concrete practices, experiences, and possibly effective solutions of individual farmers who were by necessity already probing new solutions to meet daily challenges (The Diplomat 2017a,b; Quang and Weatherby 2019).

In considering T-learning, we also draw attention to farmers' climate vulnerability and adaptive capacity. Scaling down to local level, two community-based climate adaptation projects in Phong Dien District (Can Tho City) and Phong Dien Commune (Ca Mau Province) that are different in terms of geographical and socio-economic features were selected as case studies (see Figure 1). This section targets realities in these two areas in the Mekong Delta by way of two detailed case studies. Phong Dien is a

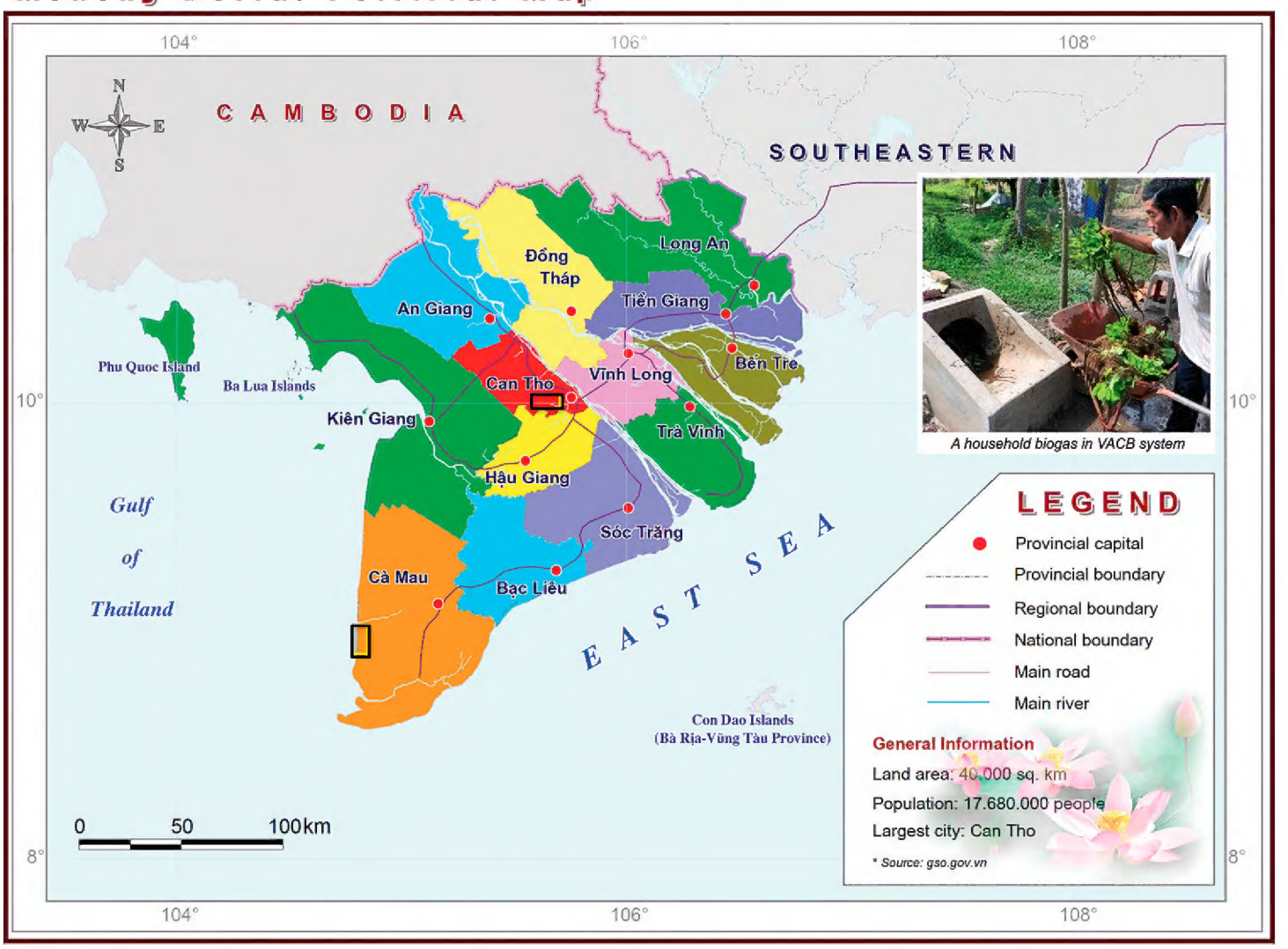

Figure 1. Areas of study (marked as black rectangles) in the Mekong Delta (by Authors).

district on the outskirts of Can Tho City – which is the central city in the Mekong Delta. It is well known for its floating market, paddy fields, and picturesque rural canals – and surrounded by water in massive waterways all somehow linked to the mighty Mekong. In contrast, the Phong Dien Commune of Ca Mau Province could hardly be more remote as it is located in the southernmost tip of Vietnam on the Gulf of Thailand. Its population is largely poor, unskilled and much more exposed to sea level rise, intrusion of salty water and extreme weather conditions. Since 2000, local farmers in Phong Dien Commune have been mobilized to switch from rice farming to shrimp farming, followed by industrialization, which has caused ecological conflicts due to huge deforestation and environmental pollution (Quang and Weatherby 2019). The following subsections aim to provide field-based analysis and some research findings to contribute to theorizing the role of T-learning in grassroots sustainable transition and climate-resilient development in the Mekong Delta.

T-learning in freshwater-based agriculture

Even while there has been relatively little attention, T-learning has been practiced in the Mekong Delta already since around 2000. It started with the engagement of a few

agricultural and environmental academics and experts from Can Tho University, starting with a limited sample of six smallholder peasants in Phong Dien District.

Owning relatively small lands of less than one hectare up to 2 hectares and using mostly family labor engaging in monoculture, notably growing one crop of rice annually, much of this was for private consumption. As rice production grew ever more problematic given climate change with yields declining year by year, they believed they were smart to shift to planting orchards with oranges and mangos. Things went well for a time. Yet they were in for a bad surprise when – in the early 1990s – extreme weather conditions and a drop in fruit prices following much more production led numerous farmers to experience financial hardship – and to bankruptcy in some cases.

The evolution of these processes of joint "learning by doing" engaging peasants and experts will be depicted in this section, targeting innovative methods under what has come to be known as the VACB model. The VACB is a poly-culture model combining 4 elements: Vườn (literally meaning orchard), "Ao" (fish farming/fishpond), "Chuồng" (livestock farm), and Biogas. The objective of this model is to increase and stabilize farmer revenues and reduce the environmental burden caused by traditional intensive monoculture. This farming system is also family-managed, with practically all labor coming from the household.

The selected farmers are those who have years-long experience in farming and recognized prestige in their villages and who committed to sharing their experiences and progress reports with their neighbors. They were supported to set up a few "sample fields" where this low-carbon and climate-resilient agricultural VACB model was employed.

In the VACB model, ***orchards (V)*** usually vary from a few hundred to five thousand square meters and are comprised of fruit- or nut-producing trees that are generally grown for commercial production. Commonly grown fruit crops include orange, pomelo, mengteng (a sour, lychee-like fruit), durian, rambutan, and mangosteen. Vegetables grown include green onion, sweet potato, cress, tomato, cabbage and water spinach. Both perennial and annual crops are planted to provide year-round food to the house and products for the market. ***Fishponds (A)*** are usually constructed close to the house and surrounded by orchards. There can be a few small fishponds in a 1-ha orchard, with different shapes and an average depth of 1.2–2 m. ***The livestock pens (C)*** for pigs are constructed at the corner of the orchard close to the pond. Pig dung no longer gets washed into the river or becomes concentrated around the farm because it is drained by an installed bio-digester that transforms livestock manure through anaerobic digestion into fertilizer for algae (a commonly used food source for fish) and methane gas – an environmentally benign bio-gas (Bosold 2012). ***The biogas system (B)*** digests pig dung and vegetation and generates the methane gas byproduct, which is used for cooking, generating electricity, and pumping water for irrigation in the orchards. Digested and clean organic material then are released to the surrounding fishponds where it acts as fertilizer (Bosold 2012).

After two years of implementation, the VACB sample fields have resulted in fruitful outcomes with higher incomes but minimized polluting emissions. Many research findings confirmed that the VACB model is especially beneficial for women as it reduces the time that women spend in collecting fuel, cooking, and cleaning cookware

Table 1. Number of VACB participants by gender, age, and ethnic group.

Year	Participants	Gender		Age			Ethnicity	
		Male	Female	18–45	46–60	> 60	Vietnamese	Khmer
1996	6	6	0	2	3	1	6	0
2000	110	93	17	31	37	41	102	8
2008	300	269	31	87	101	112	277	19
2012	625	497	128	137	176	312	594	31
2017	642	513	129	135	184	323	597	45

Source: Chiem (2012) and Authors' 2017 surveys

dirtied by wood-smoke. It also saves them money by eliminating the cost of commercial gas or firewood and improves their health by managing animal waste and reducing indoor air pollution from woodstoves (Bosold 2012; Chiem 2012; Clare 2017).

Since 2000, the number of participants (family representatives) has rapidly increased year by year, from 110 in 2000 to 625 in 2012 (Chiem 2012), mainly due to technical and financial supports from Can Tho University and NGOs. From 2013 to 2017, the nationwide decrease in pig prices, along with other economic shocks associated with reduced support from Can Tho University, impeded the expansion of the VACB model to other communes (see Table 1).

T-learning in a disaster-prone area: narratives from MEF's project

Obviously, in relatively remote rural areas amongst male and female farmers who have not benefited from much education – with little teaching or training in terms of creativity or independent reflection – awareness of massive, cross border and global climate change developments and impacts, is limited. Government-led climate response policies have been tentative, with examples where initial solutions became problems themselves (Mongabay 2016; The Diplomat 2017a, b). Most farmers were, and are, expected to fend for themselves and there was little evidence of community-based approaches of sharing ideas, plans and actual novel practices. But in 2018, the Mekong Environment Forum (MEF) started to implement a project to engage with, and support, local communities. MEF brought together academics, agricultural experts, male and female farmers as well as village youths who are assumed to want to learn and hopefully initiate change in their local areas. The project was implemented with financial support from the U.S. Consulate in Ho Chi Minh City, under the name "Flying Cranes Project". It has a concrete problem-solving agenda in addressing key environmental threats: extreme weather and environmental conditions, and local non-sustainable economic activities, which, in turn, often contribute to water pollution.

The project objective was to build and develop community capacity in response to environmental changes through "learning by doing" and "adult learning process" (T-learning) approaches taught through a series of citizen science training workshops.

To meet those objectives and promote grassroots sustainable transition, MEF has implemented the following activities (Mekong Environment Forum 2018):

- Five experts and eight volunteer students from Can Tho University worked together to teach local farmers and youth new technologies and mobilize them to use these techniques in their day-to-day work. The goal was to gradually shift participants' livelihoods from traditional farming practices to a modern, eco-friendly agricultural model that could meet people's economic needs without degrading local ecosystems or increasing social disorder. Twenty small-scale shrimp farmers in Phong Dien commune (a coastal commune in Ca Mau Province) were selected to engage in T-learning under the supervision of experts and volunteers.
- A 2-hectare sample field was set up in the commune by the project to employ a climate-resilient poly-culture model. This model enables farmers to diversify their crops, shifting from intensive shrimp production to poly-crop in the same pond. Thus, it helps increase household incomes and economic self-reliance since farmers can harvest different profitable crops (seagrass, fish, crab) day-to-day while waiting for the main crop (shrimp). The poly-culture model encourages farmers to restore mangrove cover in the shrimp ponds to reduce impacts from weather extremes (such as high temperatures and cyclones), increase the local ecosystem's ability to absorb waste, and to offer natural food and shelter for naturally-occurring harvestable species (oysters, shrimps, fish and crabs).

In the demonstration site, land-owners were supervised by experts to do farming in a sustainable manner while other smallholders were invited to visit and observe how new techniques work, how water quality is naturally purified by the restored seagrass and mangroves, and how the poly-culture improves revenues through add-on crops. Three field-based meetings have been organized at the sample field – a kind of informal school where participants met regularly to share information, make regular field observations, and learn new techniques through practice.

Farmers were asked to compare what they learnt from the field-based school with their own past experiences in order to better understand how eco-friendly farming practices enable them to reach a long-term balance between nature and economic return. Most participating farmers agreed that the mangroves and seagrass help reduce their spending on food for shrimp and fertilizers for water treatment. They also learnt that the poly-culture may bring less shrimp productivity than they expect, but it demonstrates the potential to offer much more stable and sustainable income sources than traditional shrimp farming. The poly-culture model is a solution for the ecological conflict between mangrove conservation and shrimp farming in Mekong Delta coastal provinces. Their responses provided feedback to the team of experts and contributed to revisions of the model that will help this approach be more effective if it is applied elsewhere. The process also provided useful field experience for experts and students and will contribute to their professional development and future research.

Research results and discussion

Whereas learning ultimately is a matter for the individual, T-Learning explicitly targets the community. Assuming that learning is much enriched if their knowledge – what individuals have learnt but also what they learnt by doing – is shared, T-learning is ultimately about community sharing and learning. On the other hand, "community" cannot be assumed as each community is marked by divisions: of wealth, land ownership, gender and political affiliation. Yet all members share similar conditions in terms of the environment, the economy, culture and society. Conceptually, Sattanno et al. (2017) envision that a sustainable community is a "community where the air and water are clean, water supplies fully meet demand, everyone enjoys access to locally supplied safe and healthy foods, wildlife flourishes, and the landscape is pleasing to the eye. Within this community, full participation and a spirit of cooperation pervade decision-making." This, admittedly, is an almost romantic ideal of a self-sustained sustainable community, yet it may serve as a benchmark to measure when and where such conditions are being met.

Bridger and Luloff (1999), Fonchingong and Fonjong (2003), and Mezirow (2009) suggest five major indicators that measure sustainable community development, namely: (i) economic diversity and resilience; (ii) grassroots self-reliance; (iii) energy and environmental security; (iv) biodiversity conservation; and (v) social justice. This article employs the first four out of these five indicators as an analytical toolbox to understand in what ways T-learning has significantly contributed to local sustainability transition in the two areas of study.

T-learning helps increase local economic diversity and resilience

In the Flying Cranes Project, the project team organized two training workshops in Phong Dien commune (March and May 2019, respectively) to raise awareness about environmental changes, water insecurity, and sustainable development concepts among local community members. Before each workshop, the team carried out surveys to collect information and understand the urgent local needs. After completing the workshop, participants were asked to fill out a questionnaire with closed and open questions. Our comparison of the survey results from before and after the workshop indicates that locals' awareness of the role mangroves play in environmental protection and local water security was significantly improved. Below are some measureable outcomes excerpted from the project report (Mekong Environment Forum 2018).

- 35% increase in productivity and economic efficiency;
- Comparatively higher levels of income and economic diversity: after four months participating farmers have harvested 3 different crops from the same pond: fresh crab, shrimp and fish. The average income per monoculture crop (4 months) of each household before participating in the project was VND

12,600,000 (approximately US$560). The average income after the first poly-culture crop harvested in early September 2018 was VND 17,000,000 (approximately US$ 756). With the polycrop, farmers can harvest some kinds of fish inhabiting the mangrove and seagrass in the shrimp pond on a daily basis. The fish species are natural inhabitants from the river and grow up by themselves thanks to the food and habitat provided by the mangrove and seagrass;

- Cost savings and additional revenues:
  - In a traditional 4-month monoculture crop, a 1-ha shrimp pond needs VND 4,500,000–6,000,000 (approximately US$ 200–300) for fertilizers and pesticides.
  - Mangrove, seagrass and new techniques improve the water quality, reducing the costs for fertilizers, waste water treatment, and preventing common diseases. Participating farmers have invested VND 1,300,000 – 2,000,000 (less than US$ 100) per poly-culture crop for fertilizers to stabilize pH and water quality in response to weather uncertainties.
  - Shrimp is the main crop, but harvesting crab, seagrass (bulrush), and fish from nature provides additional daily income for shrimp pond owners while they await shrimp growth.

Let us now consider the evidence that was collected regarding the impacts for farmers who employ the VACB system. In 2017–18, surveys followed by in-depth interviews covering 120 farmers were conducted in four communes of Phong Dien District: Truong Long, Nhon Nghia, Giai Xuan, and My Khanh (see Figure 2). Information was gathered on household-level impacts of VACB project in terms of economic, energy, environmental, and sustainability areas. The outcome of comparing the revenues generated from VACB and from traditional crops is shown in Tables 2 and 3 respectively below. Most VCAB farmers managed to double their incomes, and in addition, to spread their risks through other subsidiary crops. Importantly, such households have reduced their debts and fewer incidences where they feel forced to migrate to cities and/or work as the number of wage laborers fell.

This is confirmed in a household survey indicating a reduced dependency on remittances from family members working elsewhere (Table 2). Many VACB farmers are now in a position to enroll children in higher education or specific professional training. On the whole they appear to have gained a stronger economic condition as they are more resilient, making new choices possible that used to be elusive. Farmers adopting the VCAB system may now diversify to work with crops or animals – smartly adjusting to changes, for example an unexpected drought/flood or a price fall. Hence they may be able to reduce working time in their fields as the system is entirely closed. This leads Eyler (2019) to say that VACB farmers "bring in nothing from outside of their farm, no pesticides, fertilizers, or antibiotics to maintain its productivity".

In responses to our surveys, VACB farmers in Phong Dien stated that their daily life now includes feeding their livestock, tending their orchards, and filling biogas digesters with pig dung, water cabbage, or biomass. "We really enjoy this farming model,

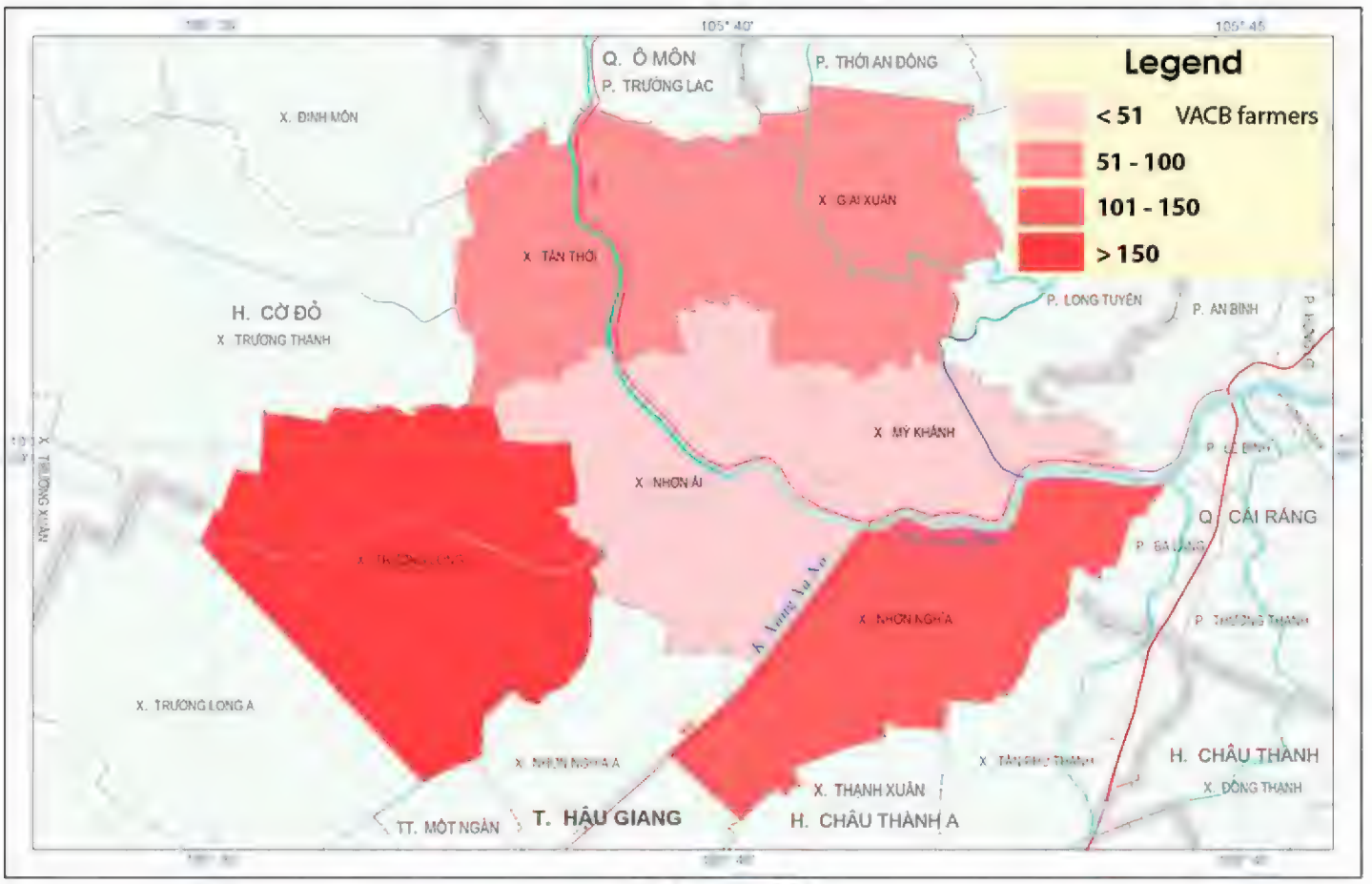

Figure 2. Distribution of VACB system by communes in Phong Dien District (by T-learning research group in Can Tho University).

Table 2. Common VACB crops and average household income in Phong Dien District.

System components	Crops		Average revenue (in VND)	Shares to family income (%)
	Main crops	Additional crops		
Orchard (5,000 sq. m)	Orange		22,000,000	13.0
	Mengteng		16,000,000	9.5
	Pomelo		11,000,000	6.5
		Vegetables	4,000,000	2.4
Fishpond (1,000 sq. m)	Snake fish		15,000,000	8.9
	Bronze featherback		12,000,000	7.1
	Red tilapia		12,000,000	7.1
		Snail	13,000,000	7.7
Pigpen (10 pigs)	Pig		42,000,000	24.9
		Chicken/duck	8,000,000	4.7
Biogas	Methane gas*		14,000,000	8.3
Sub-total			**169,000,000**	**100.0**
Other income sources				
Temporary work (seasonal income-generating jobs)			–	–
Remittance from family members			–	–
Total			**169,000,000**	**100.0**

*Using methane gas for family cooking, irrigation and lighting helps a six-member VACB household saves approx. VND 14,000,000 by reducing need for commercial gas and electricity each year.
Source: household survey in December 2017 (n = 120)

Table 3. Average annual incomes with traditional crops in Phong Dien District.

Income sources	Average revenue (in VND)	Shares to family income (%)
Rice farming	26,000,000	35.6
Temporary work (seasonal income-generating jobs)	8,000,000	11.0
Remittance from family members	24,000,000	32.9
Poultry farm	15,000,000	20.5
Total	73,000,000	100.0

Source: pre-project household survey and in-depth interviews in 2017 (n = 120) and interviews with non-VACB farmers in 2018 (n = 35)

and maintaining the system doesn't require a lot of work. Now the system can take care of itself. Sometimes, I don't have to tend to it for a few weeks," said Mr. Le Hoang Thanh, one of the proudest and most ingenious VACB farmers in the Mekong Delta.

Participants have helped university experts to train other monoculture farming households in making the transition and have also been invited to conventional events, workshops, and TV talk shows to share their success stories.

Table 3 shows that farmers who have kept on farming in the traditional ways and often grow rice as a monoculture crop, do earn less, and are less able to cope both with climate change impacts and fluctuating market prices. It is important to note that many small-scale rice farmers are women. With their incomes irregular and less predictable, they keep searching for additional incomes though temporary, poorly-paid cleaning or productive work or other income-generating activities. This appears to specifically apply to farmers with less than 0.5 hectares of land. The incidence of sons and daughters migrating to big cities or industrial zones in search of better paid work is highest here, just like the importance of monthly remittances to their families. These may make up as much as almost one-third of their family annual income (Table 3).

So although the T-learning process endeavors to engage with all sort of farmers: bigger and smaller, rice or mango, male or female, young(er) and old(er), it is critical to stress that not all of them can be easily motivated or supported to change their ways. There is a cultural, socio-economic dynamic here. Nearly 80% of the Mekong Delta people are engaged in agriculture and fishery, and have done so for generations in the context of the one party-state of Vietnam. They are often rather passive in terms of self-reliance and self-confidence, their attitudes no doubt stemming from the ideology "the state leads and all should follow" (The Diplomat 2017a). Such historical, cultural and political factors need to be acknowledged in any intervention including novel models of T-learning. Innovation, creativity and publicly proposing new ideas can be a bridge too far for many: people may remain "very superstitious and overly protective," and not open-minded (Eyler 2019). When proposing and establishing T-Learning, it is critical to first map such information and build it carefully from there – at the risk of people not getting engaged and actually becoming a challenge to new ideas or solutions.

T-learning as a tool to build and sustain community self-reliance

The basic indication of sustainability is self-reliance, especially economic self-reliance (Bridger and Luloff 1999; Fonchingong and Fonjong 2003). A community demonstrates its self-reliance by showing that its members are confident and have the capacity and skills to garner and hold economic resources to meet their essential needs in a sustainable manner (Godfrey 2008). The measure of community self-reliance is based on a diverse set of indicators which are grouped into five clusters: (i) economic inclusive development, (ii) gender equity and female empowerment, (iii) water and energy security, (iv) community education, (v) community climate resilience. These five clusters and attendant component indicators were designed in accordance with the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs).

Table 4 outlines the progress that the VACB communities in Phong Dien District have made in the given self-reliance indicator clusters. Targets were set to clarify what is meant by "demonstrated progress," and to clearly state expectations.

Given the figures shown in Table 4, the VACB communities in Phong Dien District have achieved two-thirds (17 out of 25) of targets set to demonstrate their self-reliance. The self-reliant VACB communities have also demonstrated progress in key goals that constitute the MDGs and SDGs, namely: Mobilized communities that continuously set and achieve their own development goals (Cluster 1); Empowered women and girls (Cluster 1 and 2); Improved access to safe drinking water and sanitation facilities (Cluster 3); Improved literacy and education (Cluster 1 and 4); Improved gender-equal access to and use of development resources (Cluster 2, 3 and 5); Improved land productivity and climate resilience of smallholder farmers (Cluster 5).

When the VACB communities have achieved the targets set to demonstrate their self-reliance, the VACB project gradually activates its exit strategy by reducing financial inputs and scaling down supporting activities with the exception of less-frequent staff visits and a post-project three to five months later in a select number of locations. Given that community leadership plays a key role in aiding the continuity and development of grassroots innovations, which operate in niches and require nurturing, the project's exit strategy also emphasizes training in community leadership and management.

Before this milestone was achieved, local communities went through a transition period during which T-learning workshops were the key activity to introduce new ideas and solutions without inciting doubt, dismay or concern. The workshops targeted local farmers, women, and ethnic minority representatives, many of whom are relatively conservative and not open-minded. For many years, local farmers have experienced noticeable changes to their environment that adversely affect their crop productivity, such as rising temperatures, irregular flooding and droughts, and environmental degradation.

In our training workshop, Lam Thi Suol, 41, an ethnic Khmer farmer in Phong Dien Commune, explained how she and her neighbors have been experiencing environmental changes in her village. "*It seems to be almost 2 times hotter than it was ten years ago. Drought season seems to last longer and longer with uncertain, unpredictable precipitation… In the past, we could drink water directly from rivers or pools while working in*

Table 4. Measuring VACB community self-reliance in Phong Dien District.

Cluster	Component Indicator	End target (locally set target)	Current progress
1. Economic inclusive development (MDG 1 and SDGs 1, 2: No poverty – No Hunger)	Proportion of community members are trained in income generating or livelihood activities	60–70%	63%
	Proportion of population participating in community activities, workshops, and meetings	50%	44%
	Number of community facilitators supported by local government	10 per commune	10 per commune
	Proportion of individuals reporting the ability to change their communities	10 per commune	10 per commune
	Proportion of population garnering economic surplus (revenue exceeds costs)	80% on	88%
	Proportion of ethnic minorities being benefited from the project.	60–70%	83%
	Proportion of project participants reporting the ability to meet their economic development goals	100%	100%
	Number of female trainees in workshops	45–50%	37%
2. Gender equality and women's empowerment (MDG 3 and SDG 5)	Proportion of women serving as T-learning group facilitators	30–40%	40%
	Family decision-making power	equal power	equal power
	Proportion of women supported by the project	45–50%	37%
3. Household water and energy security (MDG 7 and SDGs 6, 7)	To what extent communities are satisfying their household water and sanitation needs and improving hygiene for public health	3.0 (Capable) 4.0 (Effective)	3.0 (Capable)
	Proportion of households applying modern waste water treatment system introduced by the project (reduced household waste-water discharge)	100%	68%
	Households are able to generate electricity from renewable energy sources to meet their household basic needs (lighting, cooking, and irrigation)	Yes	Yes
	Decrease in purchasing household electricity from national power grid	Yes	Yes
	Decrease in commercial gas consumption	Yes	Yes
4. Community education	Proportion of community members trained in thematic workshops	60–70%	40%
	Proportion of households with at least one person mastering in VACB-related techniques and skills	50%	40%
	Intra-community information-sharing platform (social networks, smart phones, mobile apps, etc.)	Frequent	Frequent
	Community awareness of climate change effects and environmental issues	High	High
5. Community climate resilience (MDG 7 and SDGs 13, 15)	Misconception of climate change	No	No
	Proportion of population trained in food security and sustainable agriculture	60–70%	40%
	Proportion of households trained cost-benefit analysis	50%	40%
	Proportion of smallholders applying improved management practices and technologies on farms	60–70%	40%
	Presence of climate-resilient demonstration field in each commune	Yes	Yes

Source: household survey and in-depth interviews in 2017 (n = 120)

the rice fields. But in recent years, you see, the rivers get heavily contaminated due to saline intrusion, so we have to stop using this major water source, even for irrigation," she said.

Suol is among millions of farmers and fishermen in the Mekong Delta who completely rely on the waterways' fish resources and agricultural production for their subsistence, and have observed the changing circumstances over many years. With very low literacy rates, however, they were unable to understand the root causes of the problems they have been facing, and as a result, failed to search for a sustainable and resilient model that they could adapt their life to.

Thus, a series of T-learning workshops were regularly organized to build confidence, capacity and skills at the household and community levels. Suol and 650 other farmers in Phong Dien District (Can Tho City) and Phong Dien Commune (Ca Mau Province) have been invited to attend these workshops.

The T-learning activities in VACB and Flying Cranes projects demonstrate that changes in livelihood constitute a process of transformation in which trainees, or "T-learners," have gradually changed their mind, perception, attitude and confidence through new experiences. During the workshops, emerging environmental changes and challenges appear to serve as a disorienting dilemma forcing T-learners to reconsider their traditional perspectives and farming habits. Since most training workshops took place in local fields (orchards, fishing ponds, pastures, paddy fields, etc.), they can be described as "field-based schools" – a kind of institutional platform where participants (particularly farmers and experts) meet regularly to make information sharing, regular field observations and learn new techniques on the job. Local farmers are expected to compare what they have learnt from the field-based schools with past experiences to pursue eco-friendly farming practices that enable them to meet economic needs without degrading the local environment. In this T-learning process, local farmers were asked to work in groups in accordance with their expertise, interests, and geographical proximity.

More than 12 professional courses have been offered by CTU experts on different VACB-related topics, from horticultural diversification, swine farming techniques, swine disease prevention and treatment, fish hatching and fish stock management, to biogas plant construction and maintenance. Each training course, which was structured around a theoretical component followed by practical sessions, lasted normally from one to three days or sometimes longer and enrolled 30–40 farmers, women, and ethnic minority representatives. A few outstanding trainees from these courses were appointed to work as group facilitators to sustain and lead T-learning activities after the project completed.

T-learning promotes household-level energy and environmental security

The third sustainability dimension stresses the energy and environmental security which means that "the use of energy and material is in balance with the local ecosystem's ability to absorb waste" (Bridger and Luloff 1999). The VACB model in the

Mekong Delta is a visible example for this. In the VACB system, T-learning workshops have been organized to provide local farmers with techniques and knowledge to effectively use electricity while correctly managing the waste from agricultural activities such as straw, muck, biomass, etc. for household-level energy generation.

Since its inception until 2017, the VACB project has assisted local people in building 642 biogas digesters (Table 1). The project also organized pre- and post-installation training seminars to circulate digester-building techniques. The Viet Nam News (2014) reported that recent research findings estimate that a 2-cubic-meter bio-digester can reduce up to 3 tonnes CO_2, and each household using biogas can save 19,904 tonnes CO_2 equivalent per year due to displacing wood fuel and lowering deforestation in local forest.

The T-learning approach was also employed to make and promote behavioral changes essential to realizing the full benefits of bio-digesters. For generations, rural women have always completely relied on firewood for daily cooking. The traditional fuel, mostly collected from forests, is a free energy source for local residents; meanwhile biogas installation usually costs a family an average of VND 3,000,000 to 5,500,000 (approx. US$130–250) depending on biogas container size. Nonetheless, our household survey in December 2017 showed that using biogas for family cooking, irrigation and lighting purposes helps VACB farmers save up to VND 14,000,000 (approx. US$600) each year by reducing their need for commercial gas and electricity (Table 2). Thus, T-learning workshops were carefully designed to introduce bio-digesters as a clean, reliable and cost-effective source of power. In these workshops, we did invite farmers, who have successfully implemented the biogas system, to share their real-life experience and cost-benefit analysis. Their success stories are the ideal way to present and justify the significance of biogas. Participating farmers were asked to compare what they learnt from the field visit to biogas systems with their traditional fuel in order to better understand how the new solution matters. By doing so, T-learning activities build credibility and support for a new direction.

T-learning and biodiversity conservation

Somewhat related to the third dimension, a sustainable community is underpinned by biodiversity conservation and wise stewardship of natural resources. The results and narratives from the Flying Cranes Project are analyzed herein to clarify how T-learning contributes to fostering this sustainability dimension.

As sea level rise and saltwater intrusion into farmlands become more prolific, more and more rice farmers in coastal areas of Ca Mau Province are switching to shrimp farming as a way to sustain their livelihood. Many small-scale shrimp farmers preferred farming in an intensive way because of the higher yield. Intensive farming of shrimp crops, however, is doing harm to local ecosystems due to the overuse of chemicals to maintain water quality and mangrove clearance for shrimp farming expansion (Anh et al. 2010; Truc et al. 2018; Mongabay 2018). While local governments and greedy economic interests seem intent on boosting this high intensity, artificial style of shrimp

farming, ecological conflicts are also emerging as new threats undermining years of economic progress following on from Vietnam's newfound strength – the shrimp farming industry (Quang and Weatherby 2019). In a clash between intensive shrimp farmers trying to expand their business at all costs, and the need to protect and preserve the local ecological riches, conservation and stability is clearly losing out.

The Flying Cranes Project was designed to help address these conflicts. The pre-project survey highlights that before participating in the project, most local farmers developed intensive shrimp ponds in which they had to invest a lot of money, much of which came from loans from banks, on food for the shrimps, medicines, fertilizers, and other chemicals to use in the pond to ensure productivity. To provide more space for shrimp farming, mangroves were cleaned out since local people believe that tannic acid extracted from mangrove trees is poisonous, harmful to their shrimp productivity. The overuse of fertilizers, medications, and chemicals has resulted in negative impacts on local environment, causing serious water pollution and soil quality deterioration (Anh et al. 2010; Truc et al. 2018). As a result, local farmers were unable to sustain their shrimp ponds due to frequent epidemic diseases caused by poor water quality as well as changes in weather patterns due to climate change. After years of borrowing money, and ultimately harvests that failed, many shrimp pond owners have no choice but to sell their land to pay debts and migrate to big cities to look for off-farm jobs because they were unable to make ends meet with traditional shrimp-raising methods (Mekong Environment Forum 2018).

In response to this situation, local governments in the Delta have implemented a conservation program that requires any farming activity to meet environmental standards and prohibits mangrove clearance. However, the reality is that most shrimp farmers are reluctant to change unless they have hit rock bottom (Mongabay 2018).

Through the Flying Cranes Project's training workshops in Phong Dien Commune (Ca Mau Province), educators raised the visibility of the deplorable environmental, economic and human rights impacts of non-sustainable development projects and old-fashioned farming practices and the viability of better options. They provided information on a wide range of water and energy issues. Also, they worked to generate awareness that efficiency and small-scale, decentralized and eco-friendly solutions are essential for meeting economic needs, alleviating poverty and protecting local ecosystems. The polycrop – an integrated farming system of shrimp, mangrove and natural marine species – was introduced and employed in a sample field in the commune.

The combination of using mangrove, seagrass, and polycrop techniques appears to be a viable alternative to help the local community meet their economic needs and maintain their livelihoods while reducing pressure on ecosystems. The significant reduction in fertilizers and chemicals reduces polluted waste water from shrimp ponds (see Tables 5, 6). Mangrove and seagrass help to naturally purify water and filter pollutants in the ponds. Participating farmers also learnt that fish and sick shrimps are also a major food source for crabs. Without crabs in the pond, some sick shrimps could fuel a possible epidemic disease that would wipe out the whole shrimp pond. However, crabs will eat the sick shrimps and thereby help prevent outbreaks. Farmers concluded that

Table 5. Pollution caused by intensive shrimp farming in the Mekong Delta.

Indicator	Measured		Per ton of shrimp (average 3.5 ton/ha)	
	Value	Unit	Value	Unit
Waste water	18,260–22,640	$m^3\ ha^{-1}\ year^{-1}$	5,300–7,200	$m^3\ ton^{-1}$
BOD content	1,082	mgL^{-1}	259	$kg\ ton^{-1}$
COD content	1,866	mgL^{-1}	769	$kg\ ton^{-1}$
TSS content	6,524	mgL^{-1}	1,170	$kg\ ton^{-1}$
Total N content	49.6	mgL^{-1}	30	$kg\ ton^{-1}$
Total P content	23.8	mgL^{-1}	3.7	$kg\ ton^{-1}$
N-NH3 content	14.3	mgL^{-1}	4.8	$kg\ ton^{-1}$

Source: Anh et al. (2010) and Truc et al. (2018)

Table 6. Average water quality observed and calculated in different periods of polyculture farming.

Indicator	Pollutant load		Vietnam Standards (QCVN 11-MT:2015)	
	Value	Unit	Value	Unit
Waste water(*)	0	m^3/ha/crop	0	m^3/ha/crop
BOD content	0.032	kg/m^3	0.039	kg/m^3
COD content	0.081	kg/m^3	0.117	kg/m^3
TSS content	0.102	kg/m^3	0.16	kg/m^3
Total N content	22.71	g/m^3	48	g/m^3
Total P content	10.32	g/m^3	15.6	g/m^3
N-NH3 content	0.08	g/m^3	0.1	g/m^3

* Normally, water used in polyculture farming ponds is reused for the next crops. No wastewater, therefore, is discharged into rivers.

Source: Mekong Environment Forum (2018)

the polycrop method results in fewer epidemic disease risks than with intensive shrimp ponds. Since all pond owners discharge waste water directly into the river – which is the major water source for the whole village – switching to a polyculture model is an important investment not only for farmers but their communities more broadly.

A few weeks later, the project team came back to assess how well local farmers apply new knowledge, techniques and skills learnt from the workshops to their work and life. We recognized that local farmers have begun to change their perception and habits. Some tried to sustain the last piece of mangroves in their ponds while some others agreed to diversify their crops with high-yield marine species. They also used water monitoring techniques more frequently to observe the water quality of both river and groundwater. Understanding the negative impacts caused by wastewater discharged from neighboring intensive shrimp ponds, some farmers raised their concerns over the current policy that encourages intensive shrimp farming, but lacks serious consideration for environmental justices.

The progress from Flying Cranes Project demonstrates the role T-learning plays in transforming local perspectives and traditional practices. New ideas are often associated with difference, change, and upheaval, especially when introduced into a well-established community culture. In Phong Dien Commune, where shrimp farmers traditionally perceived mangroves as the "enemy" of shrimp productivity, and where

intensive shrimp farming remains most preferred as its potential earnings are higher, it is unlikely to persuade people to re-forest in their shrimp ponds. Thus, the positively changing perspective and habits of farmers engaged in the Flying Cranes Project demonstrates that T-learning workshops and attendant real-life experience can be an effective strategy to mobilize and support local farmers to transition to more harmonious agricultural paradigms.

The above-mentioned results and analyses reaffirm an important argument of this paper: T-learning can be seen as an appropriate form of education for sustainability since it offers unique learning opportunities for adult learners to gradually change their perspectives and behaviors through real-life experiences in on-the-ground activities. In our projects, T-learning demonstrates that it's an effective educational approach to sustainable transition communities that remain overly protective and reluctant to embrace innovative strategies. T-learning activities were designed to utilize and combine tacit knowledge, such as the ability to work, modern techniques, and community leadership, to empower local people to change and respond to their concerns in proper, sustainable, and impactful ways. In the T-learning process, smallholders are individuals who learn to change themselves and then circulate their new experiences to inspire and facilitate their neighbors to change. As the progress of T-learning has formed a nexus of multi-stakeholder relationship (local farmers, academics, policy makers, enterprises and investors), individual changes quickly increase the likelihood of a broader social change being sparked by interacting with other stakeholders and actors in the nexus.

T-Learning in sustainable transition: impediments and the role of students

The results of VACB and the Flying Cranes Project outline some issues and emerging challenges that need to be addressed in up-scaling T-learning activities in the Mekong Delta. Our focus group discussions and in-depth interviews with 120 T-learning farmers in October and December 2017 highlight a few factors and barriers that are obstructing the transformative process in grassroots communities. These are outlined in Table 7.

The first prominent challenge to the continuity and expansion of T-learning based projects is the limited support from donors (such as universities, economic stakeholders, NGOs, etc.). Almost 90% (n = 107) of respondents argued that they need seed funding, technical training and other skills to transition away from traditional practices to the new mode of livelihood. In order to help farmers who participate in T-learning projects, increased financial and technical support as well as training activities are crucial components to address the problems that remain in local communities, especially those in disaster-prone areas.

The second challenge is the lack of infrastructure to facilitate community learning (n=83). T-learning farmers live in rural villages where the means of communication and transportation remain limited or outdated. Many villages do not have adequate public spaces for community learning activities. As a result, T-learning workshops in the Mekong Delta often take place in the homes of farmers where the proper equip-

Table 7. Major factors and issues challenging the development of T-learning.

No.	Factor description	Frequency (# of respondents)
1	Lack of financial and technical supports	107
2	Lack of facilities for community learning	83
3	Policies and supports from local government	57
4	Poor commitment (farmer learners may stop pursuing the grassroots innovations whenever they find other solution which they believe can bring them higher potential earnings)	42
5	Lack of intra- and inter- community information sharing	28

Source: focus group discussions in 2017 (n = 120)

ment for training is not available, such as blackboards, flipcharts, office supplies, and projectors. Additionally, both the homeowners and participants usually find this arrangement uncomfortable.

Policies and support from local authorities also play an important role. 57 farmers who were interviewed (47.5%) pointed out that even though the T-learning process has promoted sustainability transition and poverty reduction in communities, local government authorities remain passive and, thus, have not really embraced T-learning initiatives. This explains why local government budgets are not reallocated to fund community learning centers and support training workshops. Consequently, T-learning project organizers have no choice but to apply for limited funding from donors and sponsors, such as NGOs and university research grants.

Another challenge that needs to be addressed is farmers' lack of commitment towards T-learning projects. About 35% (n = 42) of respondents contend that they might stop following farming practices introduced by T-learning activities to try other solutions if they see it could bring in higher potential earnings. This can lead to disruption and waste of supportive inputs offered by T-learning projects.

The fifth barrier impeding the up-scaling of T-learning activities is the lack of information shared between T-learning farmers and their neighbors, between farmers and experts, as well as inter-community communication. Smartphones, internet-based social networks (Facebook, Zalo, Youtube, etc.) and online resources are the most popular convenient methods of communicating and sharing information. About 23.3% (n = 28) of respondents said that they do not have a smartphone and are not familiar with those social networking apps and websites. They also find it difficult to learn and apply new techniques, especially those that require technological equipment, such as mobile sensors, to share their experience and field-work results with their neighbors, local experts, and other communities at large.

To that end, our T-learning projects have spotted many group participants who are young, well-educated farmers and university students. They have served as a bridge between local farmers and experts by helping to communicate concerns and share solutions. They have also helped connect local T-learning groups with international communities, including academic institutions and journalists. Some T-learning demonstration sites and participants, like Mr. Le Hoang Thanh, have been widely recog-

nized in books, PhD dissertations, and international magazines. Thus, local youth and students become the best choice to take over this position in T-learning projects.

Unfortunately, young people's participation remains limited in the grassroots transformative learning process in the Mekong Delta. Young farmers and students are the next generation in communities who will in time inherit the mantle of their family's farming livelihood or leadership. They typically have greater access to higher education than previous generations and keep themselves well-informed of the latest technological developments. Given the fact that local youth and students are likely to shoulder the negative impacts posed by present-day developments, it is vital that they assume an increased role in the grassroots T-learning process. Furthermore, engaging in T-learning projects offers local students ample opportunity to employ what they have learnt in school to assist their community. The real-life experience from demonstration sites, in turn, provides best "disorienting dilemmas" and aspirations for their self-reflection, self-adjustment and changes. Without such a connection between grassroots T-learning and school-based T-learning, students may not effectively promote the transforming process.

Concluding remarks

Against the backdrop of a relatively acute environmental crisis in parts of the Mekong Delta, this paper aimed to outline an innovative approach of "bottom-up" learning and sharing amongst and for at-risk grassroots communities: T-learning evolved as a counterforce to rather "top-down" climate change policy by starting from local realities. It includes both a focus on specific local environmental problems, and targeting local consultation, mapping and sharing learning-by-doing processes, and community strengthening through capacity development. There have been rather too many ill-conceived development projects with ever changing components, leading to what we can term "disorienting dilemmas" that force poorly-educated small-scale farmers, women, and ethnic minorities often in remote areas to transition to a low-carbon, sustainable economy.

Based on a detailed investigation of two Mekong Delta districts where T-learning has been introduced in recent years, initial findings indicate that T-learning can be a viable, effective and attractive approach to empower peasants to have a voice and to be taken seriously as practitioners or citizen scientists in their own domain. Comparing case studies from Phong Dien District and the quite different Phong Dien Commune did indeed confirm that community climate-resilient initiatives may need different framing and targeting due to various physical and socioeconomic conditions, and what works in one context or area may not work in another. Yet, the T-learning strategy implemented in the two case studies itself proved neutral and effective as a tool to be employed uniformly. It was shown that T-learning should be considered as an adult-learning approach which allows for, even promotes novel grassroots innovations. And if it works well, new insights, unexpected views or interpretations can in turn be applied by policy makers for development and implementation.

As was shown in the two case studies, the success or effectiveness of T-learning is greatly enhanced if local level policy makers get engaged in such learning and knowl-

edge sharing processes. Yet T-learning harbors more appropriate climate and environmentally-friendly methods. The case studies showed that it already led to increased self-confidence among affected farmers, while reducing levels of doubt, dismay or concern. For many people, T-learning was a unique experience as they were taken seriously as adult learners. Local farmers broadened their horizons, and participated in sessions and seminars, meeting and talking to likeminded individuals in similar fixes. Impacts were also shown in terms of community development as new ties and alliances emerged beyond households, and among local stakeholders. Key strategies in this specific type of adult education include concrete matters such as initial seed funding and technical training, the transfer of specific technology or methods, capacity development for community leadership and improved participant commitment.

Finally, the paper contributes field-based evidence to demonstrate that T-learning is indeed a viable bottom-up approach to come to grips with very urgent negative dynamics of environmental distress and alarming signs of climate change affecting the Mekong Delta farmers. It offers a model of local level engagement which can contribute to climate-resilient development for vulnerable grassroots communities in Vietnam, and neighboring countries that share many of the same issues. Four major measures of sustainable community development that T-learning has significantly contributed in the research sites include economic diversity and resilience; grassroots self-reliance; energy and environmental security; and biodiversity conservation. With a view to further enhancing the relevance and geographical spread of the approach it is proposed to work towards establishing "field-based schools" which can be a transfer point for real-life local experiences and lessons learnt and shared under such an incremental learning process by doing trajectories. If these were to also include policy makers and, where interested, commune and higher level officers join and get engaged, it could grow into novel and constructive ways of multi-stakeholder climate action.

Mekong Delta farmers have shown themselves over many years to be flexible by adapting to ever changing environments and climate impacts. T-learning offers the potential to start from their realities, their trials and errors to keep afloat in view of the sustainable livelihoods that they deserve. Once convinced through local discussions, expert advice and ideally government blessing, they will be more willing to change their practices and work collectively towards a better future.

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